REMARKS/ARGUMENTS

Claims 1-3 and 5-8 are pending herein. Claims 5-7 were withdrawn from consideration by the PTO. Claim 1 has been amended to incorporate the content of pending claim 4. Claim 4 has been canceled without prejudice or disclaimer. Applicants respectfully submit that no new matter has been added.

Applicants respectfully submit that this Amendment After Final Rejection is proper under Rule 1.116 and should thus be entered, because it simply incorporates dependent claim 4 into independent claim 1. As such, this Amendment After Final Rejection places at least claim 1 (and all claims depending therefrom) in condition for allowance without creating any new issues for Examiner Turocy to consider.

1. Claims 1-4 were rejected under §103(a) over Yara. To the extent that this rejection may be applied against the amended claims, it is respectfully traversed.

Amended claim 1 recites a method of producing a thin film using opposing electrodes, the method including the step of applying a pulse voltage on the opposing electrodes under a pressure of 100 to 1600 Torr in an atmosphere containing a gaseous raw material including a carbon source to generate a discharge plasma to form a thin film on a substrate. Amended claim 1 further recites that the pulse voltage has a pulse duration of shorter than 1000 nsec and the thin film comprises diamond-like carbon.

Yara discloses producing thin carbon films at low temperature by creating a plasma by setting a solid dielectric on an opposing plane of counter electrodes and applying a pulse electric field between the electrodes in an atmosphere containing carbon and oxygen and/or hydrogen under a pressure near atmospheric pressure.

The PTO's asserted *prima facie* case of obviousness is incorrect, because the cited reference, Yara, teaches away from using a pulse duration of ***less than*** 1000 nsec, as claimed. Further, the facts of this case are completely distinguishable from the *Titanium Metals Corporation of America v. Banner* case cited in the Office Action, because in *Titanium Metals*, the claimed ranges were percentages of molybdenum and nickel metals in a titanium alloy composition and the disclosed percentages in the prior art reference (i.e., 0.25% Mo with 0.75% Ni, and 0.31% Mo with 0.94% Ni) bracketed the claimed alloy composition range of 0.3% Mo and 0.8% Ni. In contrast, the claimed pressure and pulse duration do not relate to a compositional feature encompassed within specific compositional examples in the prior art. In fact, the pulse length disclosed in Example 1 and the Comparative Examples of Yara is 20 microseconds (see Yara, paragraph [0051] – [0055]), which is several orders of magnitude greater than the upper limit in the claimed range of less than 1000 nsec.

Moreover, the Examiner's asserted expectation that the carbon this film resulting from the process of Yara would exhibit similar properties to the claimed diamond-like carbon film formed using the claimed voltage pulse duration is refuted by (a) the disclosure of Yara which teaches away from using pulse durations of less than 1 millisecond (i.e., 1000 nsec) stating "if [pulse duration time] is shorter than 1 millisecond, the discharge becomes unstable" (Yara at paragraph [0025]), and (b) the disclosure in the present application, which states that pulse durations of less than 1000 nsec provide a thin film of improved quality (see specification at paragraph

[0012]). With respect to the disclosure of Yara, a *prima facie* case of obviousness can be rebutted by showing that the prior art teaches away from the claimed invention in accordance with the MPEP Section 2144.05. As stated above, Yara teaches away from using pulse durations of less than 1000 nsec. With respect to the improvement in quality of the diamond-like carbon film produced by the present invention, the spectroscopic analysis difference in the main peak frequencies of Yara and the present invention (1580 cm^{-1} v. 1332 cm^{-1}) clearly shows the improved quality of the claimed diamond-like carbon thin film (see specification at paragraph [0030]). Thus, the claimed pulse duration provides a non-obvious improvement in the quality of the formed diamond-like carbon film.

Based on the above, Yara fails to teach or suggest each and every element of amended claim 1 and the present invention provides a non-obvious improvement in the quality of the formed diamond-like thin film. Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw this rejection.

2. Claims 1-4 and 8 were rejected under §103(a) over Yara in view of Mizuno. To the extent that this rejection may be applied against the amended claims, it is respectfully traversed.

The elements of amended claim 1 and the disclosure of Yara are discussed above. Mizuno discloses using a high voltage with an ultra short pulse discharge to achieve an active control of a plasma used for CVD processing. Applicants respectfully submit that the arguments submitted above distinguish claims 1-4 from Yara and Mizuno fails to overcome the deficiencies of Yara. Further, the method

disclosed by Mizuno is used to produce a thin film under a high vacuum atmosphere and would not generate a discharge plasma when used under near atmospheric pressure, as is the case in the process disclosed in Yara.

Specifically, on page 67, Mizuno discloses voltage and current waveforms to form a plasma at a pressure of 4 Torr in a time lag of 30 nsec and at a pressure of 10 Torr in a time lag of 150 nsec, as shown in Fig. 3 of Mizuno. Further, Mizuno concludes that a pulse width must always be longer than the time lag, because when the pulse width is shorter than the time lag, it is impossible to generate a discharge plasma (see Mizuno, page 659). Additionally, Fig. 5 of Mizuno shows the relationship between the time lag and the feed provided by the $\sqrt{P}$. As shown in Fig. 5 of Mizuno, the lag time of the current rise increases with increases in pressure or decreases in voltage. Mizuno discloses that V/P is the dominant factor for the initiation of a discharge plasma (see Mizuno page 658-659).

According to the attached extrapolation of Fig. 5 of Mizuno, the value of $V/\sqrt{P}$ (horizontal axis) should be 0.3 or greater to achieve a time lag (vertical axis) of 1000 nsec or less. According to Fig. 4 of Mizuno, the maximum voltage is 2.5 Torr volts. Using these values to determine the pressure provides the following result:

$$0.3 = (2.5Kv)/\sqrt{P} = 69Torr\,.$$

This calculated pressure is consistent with the description of all pressure values of 4 and 10 Torr in Mizuno. Thus, the calculated pressure demonstrates that using the method disclosed by Yara with a pulse duration shorter than 1000 nsec, based on Mizuno, would not successfully generate a discharge plasma, as asserted by the

Examiner in the Office Action. Thus, the combined teachings of Yara and Mizuno fail to teach or suggest each and every element of claim 1 of the present invention.

Based on the above, the combination of references would not have rendered the present invention obvious as asserted by the PTO in the Office Action. Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw this rejection.

For at least the foregoing reasons, Applicants respectfully submit that all pending claims herein define patentable subject matter over the art of record.

If the Examiner believes that contact with Applicants' attorney would be advantageous toward the disposition of this case, the Examiner is herein requested to call Applicants' attorney at the phone number noted below.

The Commissioner is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-1446.

Respectfully submitted,

January 29, 2008
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SPB:JAW:jms
Enclosure: Extrapolation of Fig. 5 of Mizuno

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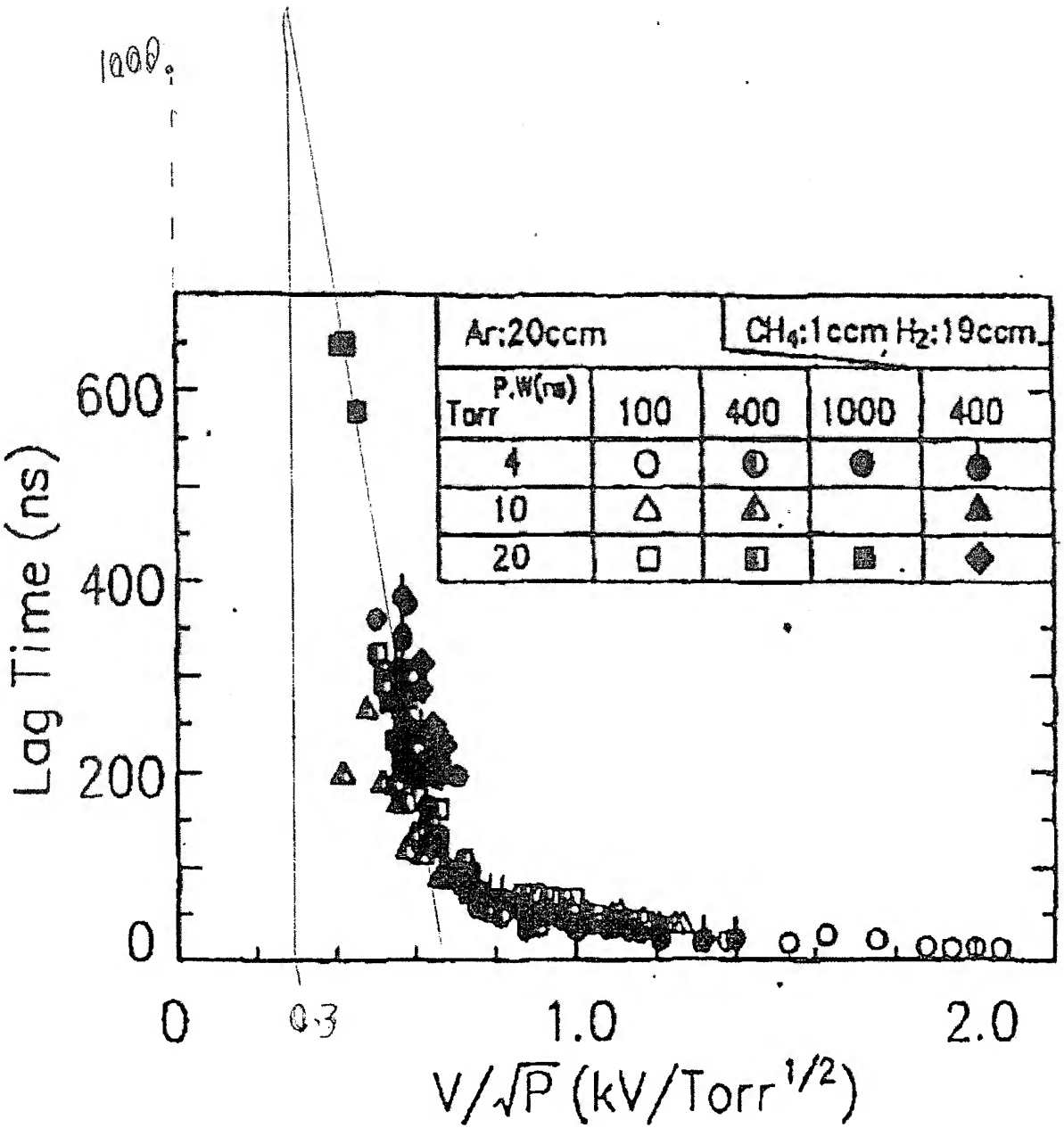
Fig. 5


1000
600
400
200
0
Lag Time (ns)
Ar:20ccm
CH4:1ccm H2:19ccm
Torr P.W(mW)
100
400
1000
400
4
10
20
0
0.3
1.0
2.0
V/√P (kV/Torr^1/2)